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prescribed studies gained less than 60 per cent, ten years later one-half of the seniors obtained four-fifths of a perfect mark in four electives.

Two objections may here be raised; viz., that the selected courses will have but little connection with each other, and that the easiest ones will always be the favorites. An answer to the first objection is contained in the fact that nearly one-half of the last senior class chose at least three closely related courses. The charge of 'soft' courses is the stock objection to the elective system, and seems, *a priori*, a sound one. The subjoined list of the courses which in 1883-84 were most largely attended by seniors and juniors, shows that, when choice gets full play, the factor of interest may make a severe study popular.

The courses were: Mill's political economy, 125 seniors and juniors; later European history, 102; history of ancient art, 80; comparative zoölogy, 58; political and constitutional history of the United States, 56; psychology, 52; geology, 47; constitutional government of England and the United States, 45. Are not these studies just those which should be the most popular?

It may be asked how such wise selections are secured, and we answer, simply by making them deliberate. In June the students must choose their studies for the next year, and notify the dean of their choice. Until Sept. 21, any elective may be changed, on notice sent to the dean. During the first ten days of the term no changes are allowed, but afterwards for a short time they are easily effected. For the remainder of the year no change is possible, except for urgent reasons.

By these means the faculty tries to avoid waste of time over unprofitable studies. Of course, not seldom unwise choices are made; but is not that true to an even greater extent in the case of prescribed studies? Moreover, the wastes of prescription affect chiefly the energetic and original students, while under the elective system it is especially the shiftless and dull who suffer, that is, men who cannot be much harmed by any system.

Then, how much the instruction under the two systems differs! When studies are prescribed, the teaching becomes often a secondary affair, and the pupils have to be urged to work. Under the elective system the student feels that he has something at stake, and a higher style of teaching becomes possible. Theses are read, and original works consulted. During 1860-61 only 56 per cent of the Harvard undergraduates consulted the college library; during 1883-84, 85 per cent.

Then, again, under the new system at Harvard, attendance at lectures is not compulsory; though, of course, a lengthened absence would

not be permitted. The results obtained from trusting the students have been satisfactory. In the last senior class the total absences, whether from sickness, misdeeds, or other causes, amounted to but 16 per cent of the total number of recitations. Colleges requiring attendance seldom show better results.

But when studies are elective, professors are benefited equally with students. Teacher and taught are brought closer together, a common sympathy animating both alike. The professor, too, gets to see himself as others see him, and, if inefficient, his class soon dwindles away. Both professors and students are, in fact, put on their good behavior.

But why introduce the elective system so early as the freshman year? First, because the youth of eighteen needs just such a happy influence on his character as the system gives; second, because the loss of time incident to learning to choose can best be borne in the earlier, that is, least valuable, college years; while, last, the change from school to character methods is too important to be marked by the mere passage from one class to another. A change of residence should mark it. A character-college, then, while no place for the indolent rich, is best suited for the democratic many, to whom the elective system gives an opportunity for mental and moral expansion which no compulsory system can afford.

We must, however, remind the reader that the system is not yet perfected, and has still many imperfections. Convinced, as we are, of the soundness of its method, we invite criticism, which should now turn to the important work of bettering its details of operation.

ENSILAGE IN ENGLAND.

In a return to the house of commons, entitled 'Ensilage commission, evidence, part i., Preliminary report and minutes of evidence,' and in a 'Return of the replies to questions relating to silos and ensilage put by the agricultural department, privy council,' which have lately reached us, the latest information is contained in regard to the views held in Great Britain as to the value of silos and ensilage, and the practical successes and experiences with this still somewhat experimental method of preserving and feeding various kinds of green food to stock, in an undried condition.

The evidence obtained voluntarily by the parliamentary commission from thirty-eight witnesses, including Sir John B. Lawes, Viscount De Celles, and the owners and occupants of many large estates, their agents and tenants, and the inventors of different forms of silos, not excluding

any testimony of an unfavorable nature, but endeavoring to induce persons believed to be opposed to the system to give their opinion, has in their opinion, without exception, established the claims of the system to a considerable amount of success ; and, although in some cases the results have been evidently more satisfactory than in others, nevertheless, all the systems seem to show that a nourishing, useful food for animals can be preserved, independently of any drying process, within wide lines of divergence in the details of the methods adopted. Different degrees of weighting and of exclusion of atmospheric air are the causes of different degrees of heat, and of consequent chemical change produced. It is apparently, as yet, largely a matter of opinion whether such chemical changes increase or diminish the feeding value of the ensilage, or its relative value in comparison to the green crop. The solution of this question the commissioners naturally regard as of great importance, and consider that careful feeding experiments, conducted with a view to test the exact effect of these changes, are very desirable. They find that whether the ensilage has been covered in immediately after cutting, or put in at intervals, the air not being immediately excluded and considerable heat developed, yet in both cases a useful feeding material has been obtained which would have been lost if any attempt had been made to convert it to hay in unfavorable weather.

As to the economy of different systems of making and storing ensilage, the commission is not prepared to express an opinion ; nor does it desire at present to compare the advantages of different systems, the quality of the ensilage being not materially affected thereby. Special circumstances affecting particular localities must influence and regulate the methods employed. It was found that some of the best ensilage was produced with a pressure of not more than seventy pounds per square foot, but the degree to which weighting is necessary or desirable remains to be decided. Good results are claimed with weights between seven and three hundred pounds. Evidence shows that all differences in actual results, not dependent on composition of food-plants employed, are traceable to the variations in the degree to which fermentation is allowed to be set up in the silo, and the length of time it is continued. The fermentation, too, is controlled by or dependent on the manner of constructing, filling, covering, and weighting.

The testimony of the dairy farmers does not appear to justify the assertion, which has been more or less circulated, that dairy products are affected by ensilage ; on the contrary, there is

much valuable evidence to show that well-made ensilage distinctly improves the yield of milk and cream, and the quality of the butter. This is of interest on this side of the water, as a similar report has gained ground here, without, as far as has been learned from our investigations, any reason, unless the ensilage is fed too soon after coming from the silo. It should be exposed, at least in the case of sour maize ensilage, for a period of twenty-four hours to remove an odor which sometimes affects the milk when the feed is fresh. Tainting of the milk, the commission considers to have been due in many cases to proximity to strong-smelling ensilage after milking. The report concludes by saying that they have heard sufficient evidence to warrant the extension and development of the system as a valuable auxiliary to the farm.

The second part of the report of the commission, soon to appear, will contain the documentary evidence obtained in answer to twenty-five practical questions sent to the proprietors of silos in various parts of the kingdom. We have before us the answers to similar questions sent out by the agricultural department, privy council, which have been published in the second report which has been alluded to, in much the same way as was done by the U. S. department of agriculture two years ago. From the summary of the replies, we learn that the silos in Great Britain have doubled in number in the space of twelve months, that they vary in capacity from 96 to 55,440 cubic feet, averaging 2,801, and that they are built both with and without provision for drainage, but largely without. Drainage, it is suggested, requires care to prevent admission of air, and, we would add, loss of nutrients when the pressure is not properly regulated. The construction of the silos varies in material and location according to the locality where they are built. Any material furnishing the absolute requisite of rendering the walls air-tight seems suitable and successful, and localities where there is sufficient difference to enable the filling to be done at one level, and the drawing-out at a lower one, seem to be most favorable. Oats, green barley and wheat, maize, buckwheat, sanfoin, rye and all sorts of grasses, hop-vine, turnip tops, peas and beans, with mowings from hedges, and fences, and ditches, including nettles, sedges, and rushes, have all been more or less successfully made into palatable ensilage. The addition of salt was mentioned unfavorably in many reports, as was the case with the testimony before the parliamentary commission. The methods of compression have varied very much, but dead weight has been largely employed, and water-tanks so arranged as to be air-

tight covers have been successful in some cases. Opinion seems to be in favor of some simple method of lever pressure as economizing labor. Replies as to the influence of the weather, or temperature and moisture, show that success has been met with in both wet and dry weather, but that there should be no long exposure to the sun after being cut. Young crops make the best ensilage, and attention should therefore be paid to the condition of maturity. The temperature in various silos has been found to vary from no perceptible increase in heat to 150° F.; and according to the temperature at which fermentation goes on, sour or sweet ensilage is produced. A certain amount of exposure before closing the silo seems to have been most satisfactory. In some instances the silos have been opened and refilled as often as became expedient, the period extending over several weeks. At other times they have been filled and closed at once, with not entirely satisfactory results, as it has given a very sour ensilage, with strong odor, when the crop was put in wet; but in other cases the results from grass packed when perfectly wet have been altogether encouraging, even from mere earth-pits. As regards cost, it is stated that on the whole, as far as present experience enables one to form a judgment, the cost of making ensilage is less than that of making hay, more especially when wet weather prevails. Of 164 recorded opinions 72 make the cost of ensilage less than that of hay when it is made in fine weather, while 72 make it about equal, and 20 state that hay-making is cheaper. Deterioration from moulding was generally found for a few inches, but even when there was much deterioration, apparently, and the ensilage was sour and unpalatable, exposure for a few hours was all that was necessary to make stock eat it eagerly. Injury of this description is attributed to loose packing near the walls, and to leaks admitting air at doorways. Cases are rare where deterioration led to discouragement.

The results of feeding stock upon ensilage, especially dairy cows, and its effect on the quality and quantity of milk, the report states as follows:—

"It is often said to be preferred to all other fodder by dairy stock, as well as by horses, and to be less costly than the usual food. A marked increase in the quantity, and improvement in the quality, of milk and butter, appear generally, and accompany the change from dry fodder to ensilage as part of the regular food, and, when used with cake and meal, there is occasional mention of decided advance in condition. Cows appear, however, in a few instances, to have been fed entirely on ensilage for some months with good results, and it is added in numerous returns that more stock can be kept in winter upon land by the use of ensilage, while it is an excellent and economical substitute for roots."

"The recorded opinions of those who have tested its

effects in regard to milk and butter assume the following proportions:—

	Milk.	Butter.
No change.....	22	1
Improved in quantity and quality.....	95	18
Decreased quantity and deteriorated quality.....	1	—
Increased quantity.....	98	13
Decreased quantity.....	5	2
Improved quality.....	34	26
Deteriorated quality.....	5	3
Improved quality and decreased quantity.....	4	—
Increased quantity and deteriorated quality.....	5	—
Favorable results (whether in quantity or quality not stated).....	30	15
Unfavorable results (similarly not stated).....	—	1
Total opinions	294	79

"Disagreeable smell and taste are occasionally referred to as having been present in both milk and butter, which often disappeared upon reduction of the quantity of ensilage given. With reference to this objection, it is recommended that, in feeding dairy cows with ensilage, much of it should not be near them during milking hours, and that persons so employed with it should wash their hands before milking. Ensilage is spoken of generally as a most wholesome and nutritious food for cows, and other stock are said to thrive upon it, especially when given in quantities of about half ensilage in combination with hay and other usual food. The superiority of sweet ensilage is often remarked upon, though a great many are in favor of the sour kind.

"Gain in weight is mentioned as having been tested, while loss of condition, and with cows, diminished quantity of milk, have been noticed after the ensilage made was all dispensed of.

"There are but few statements which qualify the records in these respects, and further experience will doubtless do much to remedy the disappointment occasionally expressed in regard to first experiments."

As to the manner of feeding ensilage, the report shows that it is not often used exclusively, but combined with hay, meal, or other rich food, which gives better results. The quantity of ensilage has varied from seven pounds per day, to as much as the animals would eat. The average may be considered as from twenty-five to fifty pounds, according to the age of the animal, when other food is mixed with it. The combinations of food are most varied, and many interesting experiments are given, showing a larger yield of milk on an ensilage diet than on others of mixed materials. The almost unanimous testimony of the report is favorable as to the effect on the health of stock, while in some cases the praise of its value is unstinted.

The replies to the inquiry whether ensilage had been successfully made without a silo, seem to show that it has not frequently been done. Now and then it was made in stacks above ground, or in casks, but with much waste.

The conclusion expressed in the introduction to the report ends by affirming that, of the importance of ensilage as an auxiliary to other food for animals, whether for dairy, store, or young stock, among cattle as well as other kinds of stock,

there can now be scarcely any doubt, if the sum of the aggregate result of the replies recorded may be taken as a guide. The system hitherto may be said to have been somewhat tentative ; but, if the rate of development shown in the past year continue, it appears probable that it will be far-reaching in its effect.

The system is undoubtedly peculiarly adapted to the moist climate of England ; and the success there met with, in connection with past experience of a somewhat longer and wider range in this country, certainly points to a future which will make this method of feeding stock of the greatest value to the stock and dairy farmer. The evidence of the British farmer is of particular interest, in regard to a new system of this sort, as, from his habits of intensive farming, he is perhaps more qualified to judge of it than his American fellow-laborer.

THE PANAMA CANAL.

THERE is no engineering enterprise now in progress which has excited more general interest, or the successful completion of which will affect more deeply the concerns of the commercial nations of the world than the Panama canal. As work was begun in 1880, or perhaps more accurately in 1881, and as the completion of the undertaking was promised for 1888, it is quite time to inquire what progress has been made up to the present date, and what is the prospect for the future. The book of Mr. J. C. Rodrigues,¹ which is a reprint of a series of articles written for the London *Financial news*, gives a summary of the operations from the beginning until now, with his opinion of the condition of the company, the political bearing of enterprise as regards the United States, and the impending catastrophe. It deserves a careful perusal by every thoughtful citizen, and presents a more concise, and at the same time comprehensive statement of the case than has as yet appeared.

After a brief survey of preceding explorations of the isthmus, he gives an account of the expeditions of Commander Lucien Napoleon Bonaparte Wyse, of the French navy, and of the concession he obtained from the United States of Columbia, in 1878, for a canal at the Isthmus of Panama. In 1879 the 'International scientific congress,' as it was called, at Paris, under the auspices of M. Ferdinand de Lesseps, decided to recommend the construction of a ship canal at the Isthmus of Panama, to be built without locks and as an open cut from ocean to ocean. Those American delegates to the congress who were well fitted to judge of

the facts from personal examinations, or reports of surveys at Darien, Tehuantepec, Panama, and Nicaragua, and other delegates qualified by practical experience, opposed in vain this decision, pointing out the difficulties and uncertain quantities which rendered a wise judgment and a reliable estimate impossible at that time, and urging the advantages of other sites. The enterprise, however, was to be carried on by Frenchmen ; and his success in carrying through the Suez canal, a far different undertaking in character of materials and obstacles to be overcome, was pointed to as an answer to all objections. The intention appeared to be to forestall any work which others might undertake at points which have been and still are regarded as much more favorable.

The canal congress estimated the cost of a sea-level canal at 700,000,000 francs, or £28,000,000, although a sub-committee had practically put the cost at 1,040,000,000 francs, and added that the "execution of such works, and principally that of such deep cuts, the stability of which is problematical, as well as the operations relating to the course of the river Chagres, constitute a complication of difficulties that it is impossible to estimate." There was added to the prime cost 25 per cent for unforeseen expenses, 5 per cent for expenses of banking and administration, and 3 per cent per year for interest during construction. An 'international commission' visited the isthmus in 1880, and reported that the canal would cost 843,000,000 francs, without preliminary, banking, and administrative expenses, and interest during construction, and estimating contingencies at but 10 per cent. They reported 75,000,000 cubic metres to be excavated, in place of 46,000,000 previously estimated. This estimate of cost M. de Lesseps first cut down to 658,000,000 francs, and later to 530,-000,000 francs. A more extended acquaintance with the problem has raised the estimate of quantity to 125,000,000 cubic metres.

The dredging through the low alluvial lands near the sea, and the formation of harbor works, would, of course, present no difficulty ; but the two rock-cuttings — the deepest at the Culebra, 820 feet in width at the top, containing from 25,000,000 to 30,000,000 cubic metres, of which but a small portion has yet been removed ; and the Emperador cut, not so deep, but containing about the same quantity of rock — are very formidable obstacles, which will, at the rate work has as yet progressed, require many years to overcome. There is also the uncertainty whether little or much water will be encountered in the lower portions of these cuts. The removal of rock under water will swell the cost greatly.

¹ *The Panama canal: its history, its political aspects, and financial difficulties.* By J. C. RODRIGUES. New York, Scribner, 1885.